Paper No. 21

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte WEI-YUNG HSU,
JOING-PING LU,
AUGUST J. FISCHER
and
MING-JANG HWANG

_____

Appeal No. 2001-0776
Application No. 09/276,043

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ON BRIEF

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Before WALTZ, PAWLIKOWSKI and POTEATE, Administrative Patent Judges.

PAWLIKOWSKI, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 1, 2, 4, 11, 12, 13, and 14. Claims 3 and 5-10 have been canceled.

On page 3 of the brief, appellants state that the claims do not stand or fall together. However, we note that in appellants' brief, with regard to claims 2, 4, 11, 12, and 14, appellants simply repeat the recitations in these claims, and do not argue patentability with specificity. We therefore need only consider claims 1 and 11 in this decision (we consider claim 11 because

this claim, along with claims 13 and 14, have been separately rejected in a second rejection).

Claims 1 and 11 are set forth below:

1. A fabrication method for adhering tungsten to an underlying layer of dielectric or silicon, comprising the steps of:

(a) providing an underlying layer of a dielectric or silicon;

(b) forming a thin layer of silicon over said underlying layer, said layer of silicon having a thickness less than 5nm;

(c) nitriding said thin layer of silicon to form silicon nitride layer less than the tunneling thickness of said silicon nitride layer; and

(d) depositing a layer of CVD tungsten in contact with said thin nitrided layer of silicon, said layer of tungsten adhering to said nitrided layer of silicon.

11. A fabrication method for adhering tungsten to an underlying layer of dielectric or silicon, comprising the steps of:

(a) providing an underlying layer;

(b) forming a thin layer of a first material over said underlying layer;

(c) nitriding said thin layer of first material, said nitrided layer of first material having a thickness less than the tunneling thickness of said nitrided layer of first material, and

(d) depositing a layer of CVD tungsten in contact with said thin nitrided layer of first material, said layer of tungsten adhering to said underlying layer.

The following references are relied on by the examiner as evidence of unpatentability:

Chow et al. (Chow)	4,847,111	July 11, 1989
Mendonca et al. (Mendonca)	4,749,597	June 7, 1988
Urquhart et al. (Urquhart)	5,264,070	Nov. 23, 1993
Contreras et al. (Contreras)	5,556,506	Sep. 17, 1996
Suehiro et al. (Suehiro)	5,719,410	Feb. 17, 1998
Ek et al. (Ek)	5,759,898	June 2, 1998

Claims 1, 2, 4, 11, 12, and 14 stand rejected under 35 U.S.C. § 103 as being unpatentable over Contreras in view of Urquhart, Ek, Mendonca, and further in view of Suehiro.

Claims 11, 13 and 14 stand rejected under 35 U.S.C. § 103 as being unpatentable over Chow in view of Mendonca.

OPINION

I. The rejection of claims 1, 2, 4, 11, 12, and 14

We consider claim 1 in this rejection and note that appellants argue claim 11 for the same reasons provided for claim 1 (brief, page 5).

The examiner finds that Contreras in view of Urquhart teach the steps set forth in appellants' claim 1 except for a thickness of less than 5nm (for the silicon layer in step (b)), utilizing CVD as the method for depositing the tungsten layer of step (d), and the tunneling thickness of the silicon nitride layer of step (c). The examiner relies upon the secondary references of Ek, Mendonca, and Suehiro for teaching these other aspects of appellants' claimed subject matter. See pages 4-6 of the answer.

Appellants argue that claim 1 requires, among other steps, the steps of forming a thin layer of silicon over the underlying layer wherein the silicon layer has a thickness less than 5 nm, and then nitriding this thin layer of silicon to form silicon nitride layer less than the tunneling thickness of the silicon nitride layer, as part of the process of adhering tungsten to an underlying layer (brief, page 3). On page 4 of the brief, appellants also argue that Contreras has nothing whatsoever to do with the problem of adhesion, and therefore any combination with Contreras is improper.

Firstly, we note that the reason or motivation provided in the prior art does not have to be the same as that of the applicants to establish obviousness. See In re Kemps, 97 F.3d 1427, 1430, 40 USPQ2d 1309, 1311 (Fed. Cir. 1996). Hence, we disagree with appellants' position that the combination is improper because Contreras "has nothing whatsoever to do with the problem of adhesion".

With regard to the teaching of the tunneling thickness recited in step (c), we find that Suehiro teaches that to prevent the reaction of tungsten with silicon, a reaction inhibiting film may be interposed between a polycrystalline silicon layer and a refractory metal layer. Suehiro refers to a Kokai publication as an example for disclosing that a silicon nitride film effectively prevents a molybdenum layer from reacting with a polycrystalline layer. Suehiro indicates that this publication teaches that the silicon nitride film should desirably have a thickness ranging from 1 nm to 5 nm in order to allow a tunnel current to flow between the molybdenum layer and the polycrystalline silicon layer. See column 2, lines 12-22. Hence, we agree with the examiner that Suehiro teaches the aspect of forming a silicon

nitride layer less than the tunneling thickness of the silicon nitride layer.

On page 4 of the brief, appellants also argue that even if Ek teaches a silicon layer of 5 nm or less, this is not a teaching or suggestion to provide such a layer in the combination as claimed and for the purpose as claimed. We again refer to In re Kemps, supra. We also find that Ek teaches the formation of a silicon layer having a thickness of between 2 nm and 500 nm, which encompasses the claimed value of "less than 5 nm". See column 3 lines 15-30 of Ek.

With regard to the use of a CVD method for depositing the tungsten layer in Contreras, we agree with the examiner's finding that Mendonca teaches that the CVD method is a well known method for depositing tungsten.

In view of the combination of teachings (which have been properly combined as discussed, supra), we determine that it would have been obvious to optimize the thickness of the silicon layer of Contreras in view of Urquhart such that, upon nitriding, the resultant silicon nitride layer has a thickness less than the tunneling thickness such that a tunnel current can flow. We especially make this determination in the absence of a showing of unexpected results. We also determine that the use of the CVD method to deposit tungsten is well known and therefore obvious.

In view of the above, we affirm the rejection.

II. The rejection of claims 11, 13 and 14

We consider claim 11 in this rejection.

Upon our review of the combination of Chow in view of Mendonca, we note that Chow is directed to a silicon substrate 10 having formed thereon a gate oxide 19, and then a polysilicon

gate 21 is formed on gate oxide 19, and then tungsten layer 25 is formed on top of polysilicon gate 21. See FIGS. 1A-1C and column 2, lines 1-58.

Mendonca is directed to a substrate 11 which typically comprises polysilicon, and an overlying insulating layer 13 which typically comprises silicon dioxide. An aperture is formed in layer 13, and a tungsten layer 14 is filled therein. See column 2, lines 16-30 and Figure 1 of Mendonca. Mendonca teaches to deposit the tungsten using a low pressure CVD process. The tungsten is then nitrided. See column 2, lines 55-68. Following the nitriding step, a tungsten layer is formed as desired, preferably by hydrogen reduction of tungsten hexafluoride. See column 3, lines 1-3. Therefore, Mendonca is directed to depositing on a silicon substrate, a tungsten layer, followed by nitriding the tungsten layer, followed by the deposition of tungsten on top of the nitrided tungsten layer.

To the contrary, Chow is directed to forming a gate oxide layer 19 on the top surface of substrate 11, and then a polysilicon gate is formed on top of the gate oxide layer 19, and then a tungsten layer 25 is deposited on top of the polysilicon gate 21, as stated, supra. See column 2, lines 6-46 of Chow. If one of ordinary skill in the art would incorporate the steps of Mendonca as proposed by the examiner on pages 6-7 of the answer, the intended interconnection of Chow would be destroyed, i.e., the polysilicon gate 21 would not be formed. In this context, we therefore agree with appellants' position that the combination is improper. (brief, page 6).

In view of the above, we reverse this rejection.

III. Conclusion

We **affirm** the rejection of claims 1, 2, 4, 11, 12, and 14.

We **reverse** the rejection of claims 11, 13, and 14 under 35 U.S.C. § 103 as being unpatentable over Chow in view of Mendonca.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

Thomas A. Waltz Administrative Patent Judge	)	
Beverly A. Pawlikowski Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
Linda R. Poteate Administrative Patent Judge	)	

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